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(Continued on Inside Back Cover)

THE JOURNAL OF
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Editorial Announcement

FOR several years past the American Psychological Association and H. E. Buchholz have been discussing the future of THE JOURNAL OF EDUCATIONAL PSYCHOLOGY, both desiring to insure a continuance of the JOURNAL on a high professional plane after Mr. Buchholz ceased to be active in its direction. The talks ranged from the Association's original proposal that it acquire ownership to a subsequent agreement that, should Mr. Buchholz become incapacitated, the Association would name one of its members to serve as Editorial Adviser to the Publishers.

However, in the summer of 1951 a plan was developed that was accepted as a happy solution to the problem. Mr. Buchholz and various editors have been conducting the JOURNAL since its establishment in 1910. During recent years members of the Division of Educational Psychology of the American Psychological Association have urged the Association to sponsor a periodical that the Division could regard as its own. Therefore, instead of waiting until he might be forced to retire, Mr. Buchholz has transferred editorial control of the JOURNAL to a committee of three appointed by the Association which will serve as the Board of Editors.

This Board is composed of Stephen M. Corey (Chairman), J. B. Stroud, and Wm. Clark Trow. The Board begins to function immediately, although it will be some time before material previously accepted can be published. Hereafter, all articles submitted to the JOURNAL and correspondence regarding editorial matters should be addressed to Stephen M. Corey, Teachers College, Columbia University, New York 27, N.Y.

A FACTOR ANALYSIS OF WORD FLUENCY*

DOROTHY M. KNOELL and CHESTER W. HARRIS

University of Wisconsin

Factor studies concerned with measures of word fluency have been useful largely to the extent that they have suggested hypotheses to be tested about the nature of fluency. Thurstone, whose studies of cognitive abilities have provided the impetus for numerous attempts at more definitive factor studies, was able to distinguish factorially between verbal comprehension ability (which he called V) and word fluency ability (labeled W).[1] Subsequent studies by other investigators[2] have supported the hypothesis that fluency is not a single ability, but one which must be described by at least two, and probably more than two, independent factors. The factor analysis by Taylor[3] was performed on a battery of twenty-eight tests which included word fluency tests used by Thurstone, fluency tests used in various British investigations, and ten reference tests which served to identify five of Thurstone's primary mental ability factors. Ten centroids were extracted by Taylor from the correlation matrix; three of the rotated centroids (W, F, and K) were interpreted as fluency factors.

Factor W was interpreted by Taylor as "word fluency ability, a facility in producing single, isolated words that contain one or more formal restrictions, without reference to the meaning of the words"; factor F as "ideational fluency ability, a facility in expressing ideas by the use of words and their meanings, quantity and not quality being the important thing"; and factor K as "verbal versatility, the ability to express essentially the same

---

* The present study was carried out in connection with a study of testing techniques supported by the Graduate School of the University of Wisconsin.

[1] L. L. Thurstone, *Primary Mental Abilities.* Psychometric Monographs, No. 1. Chicago: University of Chicago Press, 1938.

[2] John B. Carroll, "A Factor Analysis of Verbal Abilities," *Psychometrika*, 1941, 6, 279–307.

D. M. Johnson and F. Reynolds, "A Factor Analysis of Verbal Ability," *Psychological Record*, 1941, 4, 183–195.

Calvin W. Taylor, "A Factorial Study of Fluency in Writing," *Psychometrika*, 1947, 4, 239–262.

[3] *Ibid.*

idea by means of several different words or combinations of words."[1] The six tests which appeared to be the best measures of these three factors, in that each had a correlation of at least .30 with one of the three factors and low correlations with the other two, are First and Last Letters (W), Suffixes (W), Things Round (F), Adjectives (F), Letter-Star (K), and Synonyms (K). It is these three factors, together with the six tests which best represent them, which were studied in the present investigation.

PLAN OF THE STUDY

The present study was undertaken in an attempt to answer two kinds of questions:

1) Will the three fluency factors identified by Taylor reappear in an analysis of a similar set of data obtained from a different sample?

2) Can additional fluency factors be identified if, in addition to the single quantity score obtained from each test by Taylor and others, other kinds of scores are secured from the tests? Will these new scores provide linkages between quantity scores for the various tests?

The six fluency tests selected for use in the study are, in the order in which they were administered:

First and Last Letters: the instructions are to write as many words as possible that begin with T and end with E. Time: 4 minutes.

Suffixes: the instructions are to write as many words as possible that end in TION. Time: 4 minutes.

Synonyms: the instructions are to write three synonyms for each of eighteen words, such as dark, happy, huge. Time: 4 minutes.

Letter-Star: each item consists of two letters and two stars, in some random order with respect to choice of letters and position of letters and stars. The instructions are to write a sentence or phrase for each group of letters and stars, the restriction being that each letter or star stands for the first letter of a word; the stars can be any letter in the alphabet. An example with a possible answer is:

W * * C—Where is the candy?
Time: 9 minutes.

[1] *Ibid.*, pp. 248–251.

Adjectives: the instructions are to write all the adjectives which can be used to describe a house. Time: 4 minutes.

Things Round: the instructions are to list all the things that are round or that can be called round. Time: 4 minutes.

The tests were administered during one class period to one hundred twelve undergraduate students, sixty-three men and forty-nine women, enrolled in an introductory course in education at the University of Wisconsin. The students in the sample are subjects in an extensive study of the prediction of teaching success, and, in the preliminary remarks for the fluency testing period, they were told that we wished to study, eventually, the relation between fluency and teaching success. One test was distributed at a time to the students; directions, including several acceptable sample answers, were read aloud before work was begun on each test.

The initial scoring of the six tests was done by counting the number of acceptable items (words or phrases) produced on each test. These will be referred to below as the quantity scores. Then, an effort was made to obtain a number of other scores, the criteria for accepting such scores being objectivity in the scoring technique and satisfactory variance of the score in the sample. An attempt was made to secure similar types of scores for several tests, in order to determine whether such scores bridge the different kinds of fluency tests. A word complexity score was obtained for three tests: the number of words of two or more syllables for the First and Last Letters and Letter-Star tests, and the number of words of three or more syllables for the Suffixes test. In the scoring of the Synonyms test, it was noted that students had shown different patterns of responses, i.e., some students attempted to supply for each item the three synonyms requested, whereas other students were content to supply one or possibly two synonyms for each item, thereby reacting to all items in the test at least once. In order to study these differences, a separate score was obtained for each of the three columns in the Synonyms test.

Eleven scores were at first obtained from the Letter-Star test, six of which were included in the present study on the basis of some study of the eleven-variable matrix. In addition to the quantity and complexity scores, scores were obtained representing the number of items taking the form of commands, the number

of items which showed relationships between people (e.g., G * T * —Grace gave Tom help), the number of words which were adjectives and adverbs, and the number of popular responses. The latter score was obtained by tabulating the various responses to each group of letters and stars, and counting as a popular response each part of the sentence or phrase supplied by ten or more subjects. A kind of 'popular response' score was also obtained for the Things Round test. In obtaining the quantity score for that test, it was noted that for many students a majority of the responses fell into three categories: fruits, balls, and astronomical objects (e.g., sun, moon). Thus, an additional score was obtained for this test, representing the number of items belonging to the three most popular categories. Finally, it was noted that responses on the Adjectives test could be classified in two groups, adjectives describing characteristics objectively (e.g., color, style of architecture, size), and adjectives which suggested judgments (e.g., beauty, practicality). The number of items in the former category constituted the second score for the Adjectives test. It was realized that such scores derived from any one test may not be independent, in that they are based on the same set of responses and are in part a function of the number of responses (the quantity score).

A list of scores, together with the numbers used to identify them in subsequent tables, is given below. Numbers in parentheses are those assigned by Taylor to these same variables in his factor matrix.

1 (11). First and Last Letters: number of words produced.
2. First and Last Letters: number of words of two or more syllables.
3 (12). Suffixes: number of words produced.
4. Suffixes: number of words of three or more syllables.
5 (13). Synonyms: number of words produced in first column.
6 (13). Synonyms: number of words produced in second column.
7 (13). Synonyms: number of words produced in third column.
8 (20). Letter-Star: number of items completed.
9. Letter-Star: number of commands.
10. Letter-Star: number of items showing relationships between people.
11. Letter-Star: number of adjectives and adverbs.
12. Letter-Star: number of words of two or more syllables.

13. Letter-Star: number of popular responses.
14 (17). Adjectives: number of words produced.
15. Adjectives: number of words describing objective characteristics.
16 (26). Things Round: number of words produced.
17. Things Round: number of popular responses.

Product-moment correlations were computed for each of the seventeen variables with every other variable. In addition, the intercorrelations of the six quantity scores obtained by Taylor were used for purposes of comparison.

Factor analyses were first performed on the two sub-matrices of variables representing the quantity scores for the six tests administered in Taylor's study and in the present study (the three quantity scores for the Synonyms test being used in the latter matrix, bringing the total number of variables to eight). Then, an analysis was made of the total matrix of seventeen variables, representing all the scores obtained from the six tests administered in the present study. Different methods of factoring were used in analyzing the two sets of matrices.

ANALYSIS OF THE QUANTITY SCORES

The two matrices of intercorrelations of the quantity scores and residuals after factoring are given in Table 1. Three factors were extracted by the centroid method from the Taylor matrix, leaving residual correlations which were approximately zero. In factoring the Wisconsin matrix, however, it was necessary to extract four centroids before the residual correlations were zero. The two sets of centroids and calculated communalities are given in Table 2. A comparison of the two matrices in Table 1 indicates that the correlations between the various pairs of variables representing the same tests in the two studies tend to be quite similar. The Wisconsin correlations tend to be somewhat higher than those from the Taylor data. Similarly, the communalities of variables (3), (5), (6), (7), and (14) tend to be higher in the Wisconsin study than their counterparts in the Taylor study.

The two sets of centroids were extended and plots were made. The single extended-vector plot of the Taylor data showed three distinct pairs of variables, (11 and 12), (13 and 20), and (17 and 26). A rotation of the centroid axes was made by taking the

coördinates of these three pairs of variables as direction numbers, normalizing them to secure the T matrix, and post-multiplying the centroid matrix by $T\phi^{-1}$, ($\phi = T'T$), to obtain pattern values in the primary factor system.[1] These values were in turn reduced to the familiar simple structure values, the V

TABLE 1.—INTERCORRELATIONS AND RESIDUALS, QUANTITY SCORES, TAYLOR AND WISCONSIN MATRICES*

Taylor Matrix

Variable	11	12	13	20	17	26
11		−01	01	−01	−03	02
12	49		−02	01	03	−03
13	30	35		01	01	−01
20	26	26	40		−03	02
17	21	30	30	39		−02
26	18	16	24	27	42	

Wisconsin Matrix

Variable	1	3	5	6	7	8	14	16
1		01	01	−07	00	06	01	−05
3	50		−05	05	01	00	−05	−01
5	36	26		02	03	−02	01	01
6	31	40	51		−06	−04	02	04
7	24	26	05	59		03	01	00
8	27	37	33	27	16		00	−09
14	33	42	28	26	24	46		04
16	31	22	33	35	24	25	46	

* Decimal points have been omitted. Residuals are given in underlined numbers in the upper triangles.

matrix, given in Table 3. The three resulting factors are clearly W, K, and F, those selected for the present study from among the factors obtained by Taylor. First and Last Letters (11) and Suffixes (12) have high correlations with factor W, Synonyms (13) and the Letter-Star test (20) with factor K, and Adjectives (17) and Things Round (26) with factor F. Each variable is cor-

[1] Chester W. Harris, "Direct Rotation to Primary Structure," *Journal of Educational Psychology*, 1948, 39, 449–468.

related with only one factor, the remaining two correlations in each row of the V matrix being essentially zero.

TABLE 2.—CENTROIDS FOR QUANTITY SCORE CORRELATIONS, TAYLOR AND WISCONSIN MATRICES*

Taylor Matrix

Variable	I	II	III	Cal. h^2
11	566	380	−132	482
12	601	367	−158	521
13	580	047	247	400
20	577	−112	235	401
17	604	−308	−108	471
26	502	−373	−178	423

Wisconsin Matrix

Variable	I	II	III	IV	Cal. h^2
1	584	075	183	157	405
3	639	201	428	188	666
5	574	−226	−211	421	601
6	724	270	−432	110	796
7	503	456	−180	−338	607
8	537	−258	195	−041	394
14	626	−278	170	−241	556
16	555	−242	−157	−143	411

* Decimal points have been omitted.

Three extended-vector plots were made for the Wisconsin centroids, from which four variables were selected to build the T matrix: (3), (5), (7), and (14). The simple structure values, the V matrix given in Table 3, were then computed by the procedure outlined above. It will be noted that the three scores from the Synonyms test (5, 6, and 7) provide two of the four factors, thus accounting for the increase in the rank of the Wisconsin matrix over the one from the Taylor data, where only the total Synonyms score was used. Factor M includes variables (5) and (6), the scores for the first and second columns, while factor N includes variables (6) and (7), the second and last columns of the Synonyms test. It is possible that factor M represents a kind of speed factor in fluency, where the behavior

is that of going down the list of words given on the test and supplying the one or two synonyms for each word that come to mind quickly, rather than trying in some systematic fashion to supply the three synonyms requested for each word. Factor N may thus represent the "versatility" needed to think up the third synonym for each word. Things Round (16) has correlations of .25 with factor M and .16 with factor N, unlike (26)

TABLE 3.—SIMPLE STRUCTURE VALUES (V MATRICES) AND INTERCORRELATIONS OF THE PRIMARY FACTORS (ϕ), QUANTITY SCORES, TAYLOR AND WISCONSIN MATRICES

Taylor Matrix

Variable	W	K	F
11	.53	.01	−.02
12	.54	.01	.02
13	.06	.38	−.06
20	−.06	.37	.06
17	.02	.05	.43
26	−.02	−.05	.50
W	1.00	.65	.46
K	.65	1.00	.71
F	.46	.71	1.00

Wisconsin Matrix

Variable	L	M	N	P
1	.33	.16	.06	.04
3	.60	.00	.00	.00
5	.00	.64	.00	.00
6	−.06	.56	.61	−.15
7	.00	.00	.68	.00
8	.10	.07	−.10	.39
14	.00	.00	.00	.55
16	−.21	.25	.16	.38
L	1.00	.49	.43	.61
M	.49	1.00	.13	.49
N	.43	.13	1.00	.41
P	.61	.49	.41	1.00

in Taylor's matrix, and is generally difficult to interpret because of its complexity.

Factor L is quite similar to Taylor's W, "word fluency ability," in that First and Last Letters (1) and Suffixes (3) have high correlations with the factor, and all other variables except Things Round (16), with −.21, have essentially zero correlations with the factor. Also, variables (1) and (3) are relatively pure measures of the factor in this analysis.

Factor P is similar to Taylor's F, "ideational fluency ability," in that Adjectives (14) and Things Round (16) have high correlations with the factor. However, it has been noted that the analysis of (16) in the present matrix is rather unsatisfactory, because of its complexity and its negative correlation with factor L. Factor P differs from Taylor's F in that the Letter-Star test (8) has a high correlation with it rather than with factor K (in the Wisconsin matrix, M or N). It is not unreasonable to infer that, with the sample of college students, the behavior measured by the quantity score on the Letter-Star test is a kind of ideational fluency rather than versatility, similar to the behaviors measured by the Things Round and Adjectives tests, where concepts are important. The remaining variables have essentially zero correlations with factor P.

Briefly, then, the analysis of the quantity scores indicates:

1) The familiar factor W is given by both sets of data.

2) Taylor's F is not duplicated exactly in the Wisconsin matrix. The latter matrix suggests that the Letter-Star test is also a measure of F.

3) Separate scoring of the columns of the Synonyms test gives two factors; only the second is interpreted as Taylor's K.

ANALYSIS OF THE COMPLETE MATRIX

Intercorrelations of the seventeen variables and residual correlations after factoring are given in Table 4. A modified multiple-group approach to factoring was selected for the analysis of the complete matrix.[1] The entries in each array of the correlation matrix were first summed in four groups, to give G. The

[1] C. W. Harris and J. Schmid, Jr., "Further Application of the Principles of Direct Rotation in Factor Analysis," *Journal of Experimental Education*, 1950, 18, 175–193.

TABLE 4.—INTERCORRELATIONS AND RESIDUALS, TOTAL WISCONSIN MATRIX*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	(582)	022	020	−016	002	−073	001	040	005	068	038	001	041	004	016	004	064
2	364	(364)	−018	019	001	061	001	−037	−001	−064	−037	001	−038	001	−011	001	−065
3	504	074	(887)	004	002	011	000	034	−001	016	041	001	043	003	012	003	009
4	374	066	833	(816)	002	−007	003	−025	001	−014	−029	000	−039	002	−008	002	−007
5	356	134	258	198	(748)	002	000	003	000	000	002	003	001	006	005	003	−011
6	308	064	402	279	514	(799)	000	052	−002	075	−031	001	−006	003	002	002	028
7	243	009	261	173	054	586	(751)	001	000	001	000	001	−030	001	000	001	001
8	267	124	366	305	333	266	158	(868)	000	106	024	002	166	004	017	002	−055
9	−023	−031	121	066	042	080	091	294	(582)	000	000	000	000	002	006	000	033
10	060	−073	060	003	144	193	069	409	349	(251)	−142	000	171	000	065	000	128
11	167	075	289	246	229	030	011	716	164	059	(588)	000	045	002	−067	001	−049
12	074	091	115	167	227	081	051	701	083	180	597	(661)	002	001	001	001	−001
13	105	−029	274	181	258	126	−035	653	374	458	421	329	(412)	002	044	002	056
14	332	237	420	406	276	260	244	456	048	080	372	320	218	(816)	002	004	−001
15	176	135	220	199	240	149	107	271	−074	069	166	202	148	740	(818)	004	049
16	308	200	219	214	334	350	241	249	026	067	178	180	124	457	308	(558)	000
17	220	094	041	045	−010	066	097	042	−006	110	027	101	047	074	−020	254	(258)

* Residuals are given in underlined numbers in the upper triangle. Decimal points have been omitted. Calculated communalities are given in the diagonals.

columns of G were then extended, using the column with the largest positive entries as the divisor, and the three extended-vector plots were made. An examination of the plots indicated that the rank of the correlation matrix was probably greater than four, the number of factors postulated in the original grouping, in that the configuration did not fit the model for the projection of a four-space figure, the tetrahedron, nor that for any lesser space figure.[1] It seemed likely that a model for some higher space figure was needed; however, the size of the space could not readily be determined from the plots. It was noted from the plots that several 'boundary' planes, i.e., lines which span the configuration in such a way that all variables either help determine the line or lie to one side of it, could be located consistently on each of the plots.

This observation suggested the possibility of factoring the matrix by extracting two factors at a time, each two defining a 'boundary' plane with which several of the variables are approximately coplanar. Residual matrices then usually contain both positive and zero entries, although a poor choice of plane appears to give some large negative entries which are difficult to reduce through further factoring. The rank of the correlation matrix, and of each successive residual matrix, is thus reduced by two with the extraction of each plane. Each plane gives a pair of oblique factors, and successive planes (and pairs of factors) are orthogonal to each other. This type of factoring does not require at the outset the estimation of the communality of all the variables. A communality estimate is needed only for those variables through which planes are made to pass; the communality is computed for the remaining (n − m) variables.

This procedure may be summarized:

1) A 'boundary' plane is selected which appears to span the configuration and pass through two or more variables consistently on each of the extended-vector plots.

2) Two columns of the G matrix[2] are taken as the correlations in the arrays of two of the variables through which the plane passes; communalities are estimated for these two variables.

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[1] Chester W. Harris, "Projections of Three Types of Factor Pattern," *Journal of Experimental Education*, 1949, 17, 335–346.

[2] Harris and Schmid, *op. cit.*

3) The H and H^{-1} matrices are computed, H being the 2 by 2 matrix with the communalities of and correlation between the two variables through which the plane was passed; the multiplication GH^{-1} is performed to give two new columns of pattern-type values.

4) A residual correlation matrix is obtained by subtracting $G(GH^{-1})'$ from R.

5) Some new grouping of the variables is made, to obtain another set of extended-vector plots, and a second 'boundary' plane is selected, as in (1).

Columns in the GH^{-1} matrix, after the first two, frequently meet Thurstone's criteria for simple structure,[1] in that they contain many zero entries and few or no negative entries. Before the rotation is made, columns in the GH^{-1} matrix should be multiplied by the proper constants to make the factors unit length. A second set of constants will transform these columns of primary axis pattern values into the familiar simple axis structure values, the V matrix. It is also possible, although not necessary, to compute the orthogonal factor matrix from these data. The matrix of direction cosines, Λ_1, which rotates the uncalculated orthogonal factor matrix to V_1, and the final Λ matrix are obtained in order to compute the correlations between the final rotated factors, although radial rotations of one V matrix to another may be made without calculating the Λ matrix. The reproduced R is then secured by post-multiplying the final V by W' ($W = V(\Lambda'\Lambda)^{-1}$).

In the present study, four planes were extracted before a satisfactory final residual matrix was obtained. The first plane was made to pass through variables (5) and (7), the second through (14) and (16), the third through the centroids of (1 and 2) and of (3 and 4), and the fourth through (9) and (12). The G and GH^{-1} matrices were computed, following the procedure outlined above, and the columns of GH^{-1} were converted into simple axis structure values, the V_1 matrix given in Table 5. Radial rotations were then made until the criteria for simple structure were met for all columns; the final V matrix is given in Table 6. The Λ_1 matrix, which rotates the uncalculated orthogonal solution to V_1, is given in Table 7, and the final Λ matrix

[1] L. L. Thurstone, *Multiple-Factor Analysis.* Chicago: University of Chicago Press, 1947, p. 335.

and ϕ, the matrix of intercorrelations between the primary factors corresponding to the columns in the final V, are given in Table 8. It should be observed that the matrix of residual correlations, given in Table 4, was computed by subtracting from R the reproduced matrix obtained by post-multiplying the final V matrix by the corresponding W′.

INTERPRETATION OF THE FACTORS

The factor pattern is characterized chiefly by the large number of entries in both the rows and the columns which are very close to zero.[1] Each of the eight factors is specific to one of the six tests, with the Synonyms test and the Letter-Star test accounting for two factors each. Similarly, looking at the rows of pairs of variables instead of the factor columns in the pattern, the two scores for each test, except Letter-Star and Synonyms, are consistently together on one factor and usually have low correlations with the remaining factors. The three scores from the Synonyms test are split between two factors, with one score linking the two; also, the six scores from the Letter-Star test are included on one or both of two factors, with two scores linking the two factors. The quantity scores for First and Last Letters, Things Round, and Adjectives provide a small amount of linkage between factors, but the largest correlation of this kind is only .37. The nonquantity scores, however, supply no appreciable linkage between the factors.

Factor A includes two variables from the Synonyms test, the number of words in the first column (5) and the second column (6). The factor is similar to factor M in the sub-matrix of quantity scores, which was identified tentatively as a kind of speed factor in fluency. Since the scoring of the Synonyms test has apparently been confined in previous studies to obtaining a single total score, comparison with previously obtained factors involving the Synonyms test is somewhat difficult. The quantity scores from First and Last Letters (1) and Things Round (16) also have correlations with both factor A in the analysis of the

[1] $\pm .20$ is often taken as the zero range for values in the V matrix. In the present study, an attempt was made to maximize the number of entries in the $\pm .1$ range, thus applying a somewhat stricter standard in making the radial rotations.

complete matrix and factor M in the partial matrix, the correlation being .3 in the former and somewhat lower in the latter. The popular responses score on the Letter-Star test (13) also has a non-zero correlation with factor A; its inclusion on the factor is not inconsistent with the hypothesis that factor A represents a kind of speed in fluency.

TABLE 5.—INITIAL V MATRIX SIMPLE-AXIS STRUCTURE VALUES*

Variable	Simple-Axis Structure Values							
	A	B	C	D	E	F	G	H
1	39	25	10	06	48	16	−04	−04
2	16	00	12	13	52	−16	04	04
3	28	28	34	−15	05	74	04	−04
4	22	18	34	−08	−05	76	−04	04
5	86	00	00	00	00	00	00	00
6	55	64	−10	00	−10	12	−03	−10
7	00	86	00	00	00	00	00	00
8	37	16	37	−12	−01	08	26	66
9	04	10	03	−04	−12	09	74	00
10	16	07	03	−04	−11	−02	42	12
11	26	−01	34	−08	−06	10	12	58
12	26	04	26	−05	−09	−02	00	70
13	30	−02	18	−08	−17	15	42	23
14	30	26	67	00	00	00	00	00
15	27	10	74	−17	−10	−18	−14	−15
16	37	25	00	49	00	00	00	00
17	−01	11	−19	42	17	02	−04	17

* Decimal points have been omitted.

Factor B also includes two variables from the Synonyms test, the number of words in the second column (6) and the third column (7). The factor is similar in this respect to factor N in the sub-matrix, which was identified tentatively as Taylor's "versatility" factor. Variable (1) again has a small correlation with the factor, while the remaining variables have correlations of between $\pm .1$ with the factor.

TABLE 6.—FINAL V MATRIX SIMPLE-AXIS STRUCTURE VALUES*

Variable	Simple-Axis Structure Values							
	A	B	C	D	E	F	G	H
1	29	18	−08	−02	48	28	−06	00
2	08	−01	−04	01	53	−04	03	04
3	06	10	−04	−02	10	83	03	01
4	−02	−02	01	09	−01	82	−04	08
5	78	00	00	00	00	−06	00	06
6	54	59	−06	02	−12	09	−04	−02
7	00	83	00	00	00	06	00	06
8	07	14	00	−02	07	09	25	72
9	02	08	02	−01	−01	08	72	02
10	12	08	01	−01	−05	−05	41	14
11	−01	−03	04	03	00	10	12	61
12	01	05	00	05	−05	−06	00	73
13	15	−05	04	01	−08	12	42	26
14	−01	14	63	14	08	18	11	07
15	00	04	72	−03	−02	00	00	−07
16	27	13	37	51	00	00	07	−02
17	−01	05	01	37	14	00	−04	11

* Decimal points have been omitted.

TABLE 7.—INITIAL TRANSFORMATION MATRIX (Λ_1)*

	A	B	C	D	E	F	G	H
I	6811	6811	0000	0000	0000	0000	0000	0000
II	7322	−7322	0000	0000	0000	0000	0000	0000
III	0000	0000	4669	4669	0000	0000	0000	0000
IV	0000	0000	8843	−8843	0000	0000	0000	0000
V	0000	0000	0000	0000	6170	6170	0000	0000
VI	0000	0000	0000	0000	7870	−7870	0000	0000
VII	0000	0000	0000	0000	0000	0000	6690	6690
VIII	0000	0000	0000	0000	0000	0000	7433	−7433

* Decimal points have been omitted.

TABLE 8.—FINAL TRANSFORMATION MATRIX (Λ) AND INTERCORRELATIONS OF THE PRIMARY FACTORS (ϕ)*

Λ

	A	B	C	D	E	F	G	H
I	6186	6527	0000	0000	0000	0000	0000	0934
II	6650	−7016	0000	0000	0000	−1016	0000	0000
III	−2577	−1840	7749	5887	0596	1368	1408	−0397
IV	−2594	0507	1473	−7491	1129	2252	0268	1522
V	−0634	−1153	−4964	−0859	6060	7309	−0902	−0122
VI	0809	1687	−1141	−2880	7730	−6117	−0207	0156
VII	−1173	0396	−2302	0113	0920	−0726	6116	6576
VIII	1304	−0440	2558	−0421	1022	0808	7725	−7306

ϕ

	A	B	C	D	E	F	G	H
A	1.00	.04	.31	−.10	.06	.32	−.02	.27
B	.04	1.00	.04	.14	.01	.14	.00	−.08
C	.31	.04	1.00	−.33	.17	.26	−.20	.39
D	−.10	.14	−.33	1.00	.25	−.08	.01	−.06
E	.06	.01	.17	.25	1.00	.04	−.12	.08
F	.32	.14	.26	−.08	.04	1.00	−.02	.21
G	−.02	.00	−.20	.01	−.12	−.02	1.00	.07
H	.27	−.08	.39	−.06	.08	.21	.07	1.00

* Decimal points have been omitted in the Λ matrix.

Factor C includes the two variables from the Adjectives test, the quantity score (14) and the nunber of words describing objective characteristics (15), and the quantity score from Things Round (16). The Adjectives test variables have correlations of .6 and .7, respectively, with the factor, while the Things Round variable correlates only .4 with the factor. It thus appears that the factor is quite specific to the Adjectives test, with Things Round providing only a small amount of linkage between Factor C and Factor D.

Factor D, in turn, includes the two variables from Things Round, the quantity score (16) and the number of popular

responses (17). All other variables have correlations of approximately zero with the factor. The quantity score, it has been noted, is correlated with factors A and C, but its largest correlation (.5) is with factor D. Variable (17), popular responses, is a relatively pure measure of the factor, but correlates only .4 with it. Factor D thus appears to be specific to the Things Round test.

Factor E includes the two variables from First and Last Letters, the quantity score (1) and the number of words of two or more syllables (2). All other variables have approximately zero correlations with the factor. The word complexity score, correlating .5 with the factor, is a fairly pure measure of factor E, while the quantity score, also correlating .5, is linked with factors A, B, and F. Since no other variables are included on the factor, it is probable that the factor is specific to the First and Last Letters test.

Factor F includes the pair of variables from the Suffixes test, the quantity score (3) and the number of words of three or more syllables (4). Both variables have zero correlations with the other four factors, while correlating .8 with factor F, and are thus pure measures of the factor. The quantity scores from First and Last Letters (1) and Adjectives (14) also have small correlations with the factor, but their inclusion on the factor does not aid in interpreting it, except as a factor fairly specific to the Suffixes test.

Factor G includes four of the six scores from the Letter-Star test: the quantity score (8) with a correlation of .2, the number of commands (9) with .7, the number of items showing relationships between people (10) with .4, and the number of popular responses (13) with .4. No variables from other tests are included on the factor. Factor G may be interpreted as one kind of response pattern made to the Letter-Star stimulus: responses in the form of commands frequently involve two people (*e.g.*, G * * B—Give Mary the book; 'you,' understood, and 'Mary' are the two people related in the command), and commands tend to be so-called popular responses, given by many subjects. This behavior does not appear to be linked factorially to any great extent with other fluency measures.

Factor H also involves four variables from the Letter-Star test, the quantity score (8) with a correlation of .7, the number of

adjectives and adverbs (11) with .6, the word complexity score (12) with .7, and popular responses (13) with .3, Factor H appears to represent a second kind of response pattern on the test: subjects who make high quantity scores tend to use many adjectives and adverbs and words of two or more syllables; furthermore, some of these word groups are popular responses, although variable (13) correlates lower with factor H than with factor G. Since no variables from other tests are correlated with factor H, it appears to be specific to the Letter-Star test.

It thus appears that the factor pattern obtained in the analysis of the quantity scores was not reproduced clearly in the analysis of the total matrix of scores. The two factors representing the Synonyms test are common to both matrices, but Taylor's W and F split into two factors each in the larger matrix. Also, the Letter-Star test, which was originally included on factor K in Taylor's analysis and on factor P (corresponding to Taylor's F) in the Wisconsin analysis, now accounts for two factors. The analysis of the Letter-Star test is probably more satisfactory than that of the other tests in the battery, in that two rather distinct kinds of test behavior could be noted in the factor pattern. Similarly, the analysis of the Synonyms test permits the setting up of interesting hypotheses about the different kinds of behavior exhibited on that particular test. However, an adequate understanding of the four factors obtained for First and Last Letters, Suffixes, Things Round, and Adjectives must await some further analysis, coming from an experimental design which would insure the independence of the various scores, i.e., each score to be obtained from a different set of responses.

PERSONALITY CHARACTERISTICS OF A GROUP OF COLLEGE ART STUDENTS

WALTER R. BORG

University of Texas

INTRODUCTION

It is extremely unlikely that there is an 'artistic type' or syndrome of personality traits characteristic of all or even a majority of the graphic artists in our society. Artists seem to be a heterogeneous group in terms of nearly everything except the fact that they are artists, and even here we find some disagreement among artists as to whom the other artists are. There is also disagreement among artists as to what is or is not art. The psychologist who pursues the study of art and artists is often confused by this seeming chaos and frequently concludes that he is pursuing a will-of-the-wisp. Further observation, however, reveals that although there is much disagreement among artists, most of it revolves around new modes of artistic expression and their exponents. Within this perimeter of disagreement, however, are large areas of artistic expression on which most artists agree to a surprising extent. Such evaluative instruments as the Meier Art Judgment Test have demonstrated this agreement.

This basic agreement among most artists as to what has artistic merit and who displays artistic talent reassures the psychologist that artistic ability, though evasive, exists and can thus be measured and studied. There are two possible avenues of approach to the study of artistic ability. The first and most direct is through analysis of the artistic product. Measuring instruments to objectively study artistic production have been devised but these are of little value as they generally require a stereotyped performance in order that the product be comparable to norms used in scoring. This stereotyping eliminates the creative aspect of artistic ability and limits the test to a measure of ability to use skills and techniques which is but one small part of artistic ability.

The other approach open to the psychologist is to study artistic ability through the artist himself. Though less direct, this

approach has the advantage of a broader attack in areas where fairly objective measures are available.

The present study utilizes this latter approach by examination of the artist in terms of personality. The author is not seeking the 'artistic type' but merely looking for relationships which may help to better discover, understand and guide the artistically talented persons in our society and particularly in our schools.

REVIEW OF THE LITERATURE

Previous studies dealing with personality of artists and art students have produced few positive results. Barrett,[1] in a study of forty girls specializing in art, found that they scored somewhat differently on the Allport-Vernon Test of Values than a control group. The differences, however, were small and inconclusive. A more extensive study was made by Bryan,[3] who correlated the grade point averages of 1008 art school freshmen with the Bernreuter test for neurotic tendency, finding a correlation of $-.03$. This study would have been considerably strengthened by using upper-classmen and thus increasing the reliability of the criterion for artistic ability. Carroll[4] used the Bernreuter Test in a similar study and found no significant relationship between art ability as determined by ratings and introversion, submissiveness, or emotional stability. Flemming[5] found low correlations between ratings on forty-six traits of personality and ratings of art ability. Borg,[2] using the Bell Adjustment Inventory with eighty art college students, found no significant differences between the art student's scores and the test norms.

Spiaggia[13] compared scores of fifty male art students with fifty adult males on the Minnesota Multiphasic Personality Inventory and found a number of interesting differences. Art students scored significantly higher than the controls in mean scores on the Depression, Psychopathic Deviate, Interest, Paranoia, Psychasthenia, Schizophrenia, and Hypomanic Scales. He concludes that, "If we can safely generalize from the findings of the present paper, these results suggest that the art student, as compared to the non-art student of similar age and intelligence, is more typically introverted, exhibits a greater tendency toward depression, possesses a tendency to disregard social mores, or an inability to adjust to the outer world, and is more feminine

in his basic interest pattern. Further, he tends toward overproductivity in thought and action, these being of unusual character, and also toward compulsive behavior." (p. 288)

Prados[10] administered the Rorschach test to twenty artists. Features common to many of the subjects included "A superior mentality which emphasizes the abstract form of thinking, the logical and constructive activities, with obvious disregard for the routine problems of everyday life and a certain fear of mediocrity. . . . There is also a strong sensitiveness and emotional responsiveness to the outer world with a lack of adaptability to it." (p. 183)

In a more careful study, Roe[11] administered Rorschach and TAT tests to twenty high ranking painters. A blind analysis was made of the Rorschach results, (thus eliminating the possibility of the psychologist reading his own preconceptions into the interpretation) which revealed the test to be completely inadequate for discovering creative ability. Roe concludes in reference to the Rorschach and TAT data: "Analysis of the results showed a great variety of personality pictures, and a great range of adjustment levels in the group. Neither quantitative nor qualitative analysis of these records made it possible to establish any criteria whose presence indicated capacity to function successfully as an artist." (p. 94)

THE PROBLEM

The problem of the present investigation may be stated in the following questions:

1) Do the mean scores of college art students on the personality traits measured differ significantly from the scores of a norm group of college students?

2) To what degree are college art students homogeneous in the personality traits measured as compared with other college students?

3) Do art students score in the undesirable extremes to the same extent as the norm group on the personality traits measured?

METHOD

In the present study, one hundred twenty-one students whose major subject of study was applied art at The University of

Texas were given a battery of personality tests consisting of The Guilford-Martin Personnel Inventory, Inventory of Factors GAMIN, and An Inventory of Factors STDCR. The applied art curriculum places great stress on the production of graphic art. Students' grades are determined by a panel of faculty members on the basis of the quality of work submitted to the panel, thus eliminating most students who do not appear to have artistic ability.

The scores made by this group on the personality test battery were compared with the scores of three hundred twenty-five students in other schools and colleges at The University of Texas.

FINDINGS

A comparison of the mean scores of college art students and other college students on the thirteen personality traits measured reveals only two where a statistically significant difference exists. The art students show significantly greater tendencies towards depression and cycloid disposition than the control group, but the mean scores of both groups are close to the norm for college students given by Guilford[6] in these areas. The mean scores for college art students on all thirteen traits fall in the 4th, 5th and 6th C-scores of Guilford's norms,[6,7,8] indicating that as a group, art students are not markedly deviant in any of the personality traits measured.

The next step was to determine the number of individuals in each group who were at the extremes suggestive of maladjustment. Guilford considers scores falling in 5 to 7 C-score range as most desirable, scores in the 2 to 3 C-score range as indicative of a need for corrective measures, and scores in the 0 to 1 C-score range as extreme and for some traits suggestive of "something bordering on the pathological."[6] The per cent of college art students scoring in these extreme categories (C-scores 0 to 1, and 2 to 3) were tabulated and may be found in Table I. Figure 1 graphically compares the two groups in terms of the per cent of each scoring in the C-score range 0 through 3.

As compared with the other college students tested, the art students had a higher percentage of cases in the undesirable extremes of all traits except G (general activity) and A (ascendance-submission). It may be seen in Figure 1 that considerable

TABLE I.—COMPARISON OF PERSONALITY TEST SCORES OF COLLEGE ART STUDENTS AND OTHER COLLEGE STUDENTS

College Art Students N = 121	G	A	M	I	N	S	T	D	C	R	O	Ag	Co
Mean	13.01	19.60	17.50	30.06	22.06	18.31	39.03	25.15	31.87	43.18	41.31	29.37	54.44
σ	4.99	6.04	6.14	8.75	7.56	10.23	10.28	12.56	13.23	12.92	15.08	11.87	19.67
Per cent of cases with C-scores 0 or 1	3	2	1	3	7	4	6	7	6	2	7	15	9
Per cent of cases with C-scores 2 or 3	20	19	10	32	26	26	24	18	23	16	21	26	20
College Group N = 325													
Mean	11.34	19.94	19.87	32.41	26.01	17.13	34.5	18.83	24.38	40.80	47.25	33.23	62.02
σ	4.72	8.53	7.23	9.34	8.50	10.79	8.59	12.88	9.05	13.12	15.03	11.02	19.02
Per cent of cases with C-scores 0 or 1	6	4	6	5	6	7	2	4	2	2	3	5	2
Per cent of cases with C-scores 2 or 3	26	21	16	23	17	12	14	12	15	15	17	21	12

greater percentages of the art students scored in the undesirable extremes in Cycloid disposition, Agreeableness, Coöperativeness, and Thinking Introversional-Extraversion. As extreme scores in Trait M (Masculinity-Feminity) have no meaning, unless the sexes are considered separately, this trait was omitted from Figure 1.

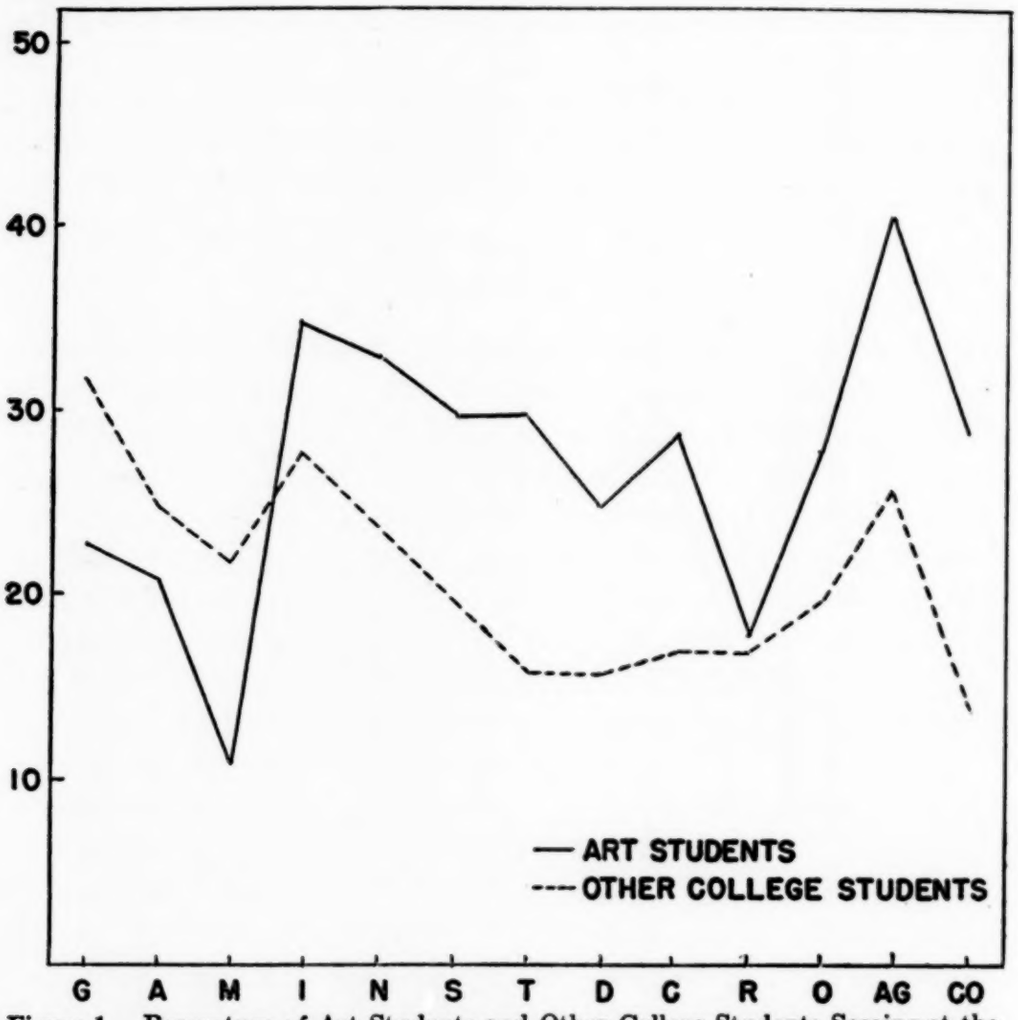

Figure 1. Percentage of Art Students and Other College Students Scoring at the Undesirable Extremes in Each of the Thirteen Traits Measured

Comparing the standard deviations of the scores of the two groups tested shows that in general the art students are a no more homogeneous group in terms of personality traits than other college students. (See Table I)

SUMMARY AND CONCLUSIONS

The Guilford-Martin personality tests were administered to one hundred twenty-one students majoring in applied art at The

University of Texas, and their scores were compared with those of three hundred twenty-five students in other schools and colleges at the University.

In reference to the questions stated at the beginning of this paper, the following conclusions may be drawn:

1) Do the mean scores of college art students on the personality traits measured differ significantly from the scores of a norm group of college students?

Art students show significantly greater tendencies toward depression and cycloid disposition as compared with the norm group, but these differences are not large.

2) To what degree are college art students homogeneous in the personality traits measured as compared with other college students?

Standard deviations of the scores of the groups tested show that art students are no more homogeneous in the personality traits measured than are other college students.

3) Do art students score in the undesirable extremes to the same extent as the norm group on the personality traits measured?

For most of the traits measured, a greater per cent of art students score in the undesirable extremes than do college students in general. The differences are greatest in traits usually included in the adult's stereotype of the artist such as cycloid disposition, agreeableness, coöperativeness, and thinking introversion.

This may indicate that observation of a few abnormal individuals determines the layman's stereotype of artists. It may also indicate that some of the persons taking the test were attempting to fit the personality stereotype that they believe typical of artists.

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MOTIVATION AS A SYNTHESIS OF CONTEMPORARY PSYCHOLOGY

RUSSELL N. CASSEL

San Diego State College

This paper will attempt to illustrate how two basic concepts of psychology, the molar and the molecular, have given rise to a single synthetic concept of motivation, which has become one of the common denominators of a systematic psychology. Some attempt will be made to show how Einstein's 'relativity theory' has been applied in the area of motivation.

Instinct Psychology.—In looking at the problem of motivation in historical retrospect, Descartes maintained that man and animal were discrete and separate organisms; that the behavior of the former was intelligent, but of the latter was 'instinctive,' or unlearned. Shortly after the middle of the Nineteenth Century Darwin, Spencer, and Huxley demonstrated to the satisfaction of many scientists the plausibility of a theory of evolution in which men and animals were continuums on the same developmental scale. The natural sequel to this theory of evolution was the emergence of 'instinct' psychology. James, McDougall, Freud, Thorndike, Jung, and others attempted to explain the basis of human behavior as being instinctive or unlearned in nature.

Conditioning Psychology.—During the early part of the Twentieth Century, Yerkes, Watson, Dunlap, and others attempted to refute the basic concept of instincts. Yerkes demonstrated how cats and mice, as well as, dogs and cats, when reared under certain planned and controlled conditions, would not attempt to attack and devour the inferior species. Watson and Jones showed that many of the fears presumed to be present at birth, such as fear of dark places, animals, people, and other things, were really not present at birth, but appeared as the result of environmental conditions. Anthropologists and sociologists added the fatal blow to the psychological existence of 'instincts' by showing that the behavior of man tends to vary with his culture. Instead of the 'instinctive' love for one's own children, Rivers reports that the Murray Islanders are indifferent to the real parentage of the child. Adoption is common and the children do not know who their real parents are.

A child may be put to death at birth if the parents feel they have too many children of the same sex. Linto reports an unusual custom in a Madagascar Tribe. When a divorced woman remarries, the former husband receives the first three children from the new union; he treats them like his own. Mead notes that in the Manus tribe of New Guinea it is the father who brings up the children, not the mother, and that the boys, not the girls, play with dolls. Fighting also has been presumed to be 'instinctive.' Boas reports that the Kwakiutl Indians of Canada settle quarrels by holding a 'potlatch' and seeing who would give away the most possessions; the one giving away the most is the victor. Goldenweiser describes Eskimos settling their disputes by holding a singing contest followed by a popular vote to determine the best performer.

With Pavlov's work as the basic experiment, Watson, Guthrie, Skinner, Spelt, Minkowski, and others have attempted to demonstrate the empirical basis of learning. If we would apply the law of parsimony; the law of contiguity, and the avoidance of retroactive inhibition we would have all that was needed to explain behavior. Any response of which the organism is capable can be conditioned to any stimulus to which it is sensitive. Minkowski maintained that all behavior was integrative in nature; beginning with the pre-reflex conditioning and ranging through the most complicated associative shifting from old stimulus to new ones. Allport proposed a motivational concept in terms of 'functional autonomy'; activity leads to further activity and it is completely divorced from its original source. The mariner who has always disliked his service at sea, a short time after he has retired, longs to return to the sea; the retired carpenter tends to want to return to his old workshop for his avocation; and the child who cried to return home with her mother on the first day of school, may wish to return to school during the first vacation.

Bond Psychology or Connectionism.—Originally Thorndike maintained that praise and blame are equal and opposite in strengthening a connection, or in facilitating learning. After 1930 he contended that praise was about five times as effective, as either lack of praise or blame; but that punishment also tended to strengthen a connection. Punishment was not believed to be as potent a strengthening means as praise by Thorndike,

but much more potent than when both praise and blame were absent. Estes, and Hurlock's investigations indicate that praise and blame, or reward and punishment, were about equally effective for short-term durations, but that praise was more effective for long-term periods. Bonus wages in industry increased production about fifty per cent, and piece-work rates effected a forty per cent efficiency upon the bonus increase. Thorndike spoke of the 'spread of effect' of reward and punishment into other areas than those in which they were administered. Wyatt and Mayo showed efficiency increases up to two hundred per cent resulting from certain attitudes, and from this and similar research a new mental hygiene program is being developed.

Organismic or Physiological Psychology.—Coghill, in describing the nature of behavior during the first ten days of life, maintained that the origin of behavior is 'differentiating' in character. Vocal sounds are first components of mass activity; social behavior arises out of mass activity. Originally the whole body is involved, but gradually the direction is toward more specific activity. Moss, Warden, and Warner attempted to establish the interrelatedness and strength of physiological drives in the organism. Warner showed that water decreased the hunger drive; and that hunger decreased the potency of the sex drive. Warden reported that maternal, thirst, and hunger were the most potent physiological drives, and that sex and curiosity ran a poor second place. Cannon and Carlson described the principle of 'homeostasis' as the basis of all behavior. The physiological structure and functions of the organism were based on organismic equilibrium; when one portion of the organism was not functioning properly, the entire animal is thrown into a state of disequilibrium until proper functioning was regained. All human or organismic behavior was described as emerging from this disequilibrium, and directed psycho-physiologically toward regaining the equilibrium.

Gestalt Psychology.—Kohler postulated 'perception' as the new basic unit of learning. He maintained that the old basic units of sense and the reflex arc did not account for insight. The laws of *pragnaz*, and the law of closure were restatements of the principle of homeostasis in a psychological setting. The direction of behavior is toward an end situation which brings

closure with it. Parts of wholes are seen as incomplete, and a tension is set up toward completion. The achievement of this completion or closure is satisfying. The law of continuation was borrowed from physics; organization in perception is such that a straight line tends to continue as a straight line, a circle as a circle, and so on. Our apperceptive mass, or past experience, determines the number and quality of cues necessary for closure. Heterogenous subjects tend to form the figure, while homeogenous figures tend to form the ground. When they are about equally divided, there is continuous interchange between figure and ground relationships or positions.

Depth or Clinical Psychology.—Many of the authors who have written about depth or clinical psychology have been mentioned above in connection with other conceptions of motivation. In depth psychology, however, new terms and new concepts were emerging, such as needs, propensities, mechanisms, dynamisms, situational-set, goal-set, intrinsic, and extrinsic motivation. Thomas, Murray, Schaffer, Horney, and others described the basic needs of the organism. In general, these tended to fall into two classes; (1) physiological or viscerogenic, and (2) psychological, personality, or psychogenic. Masserman has contended that all needs are actuated by physiological needs, but are later carried on, in some instances, independent of them. He cites as evidence the fact that a male child castrated in early infancy rarely develops the sex drive, but if castration occurs after he has had satisfactory heterosexual experiences, he may continue to seek and consumate them successfully despite the absence of the specific hormonal stimulants. The influence of the early life of the child on his later behavior gave rise to Freud's principle of psychic-determinism, or the concept that the origin of behavior is genetic or longitudinal in character; that the early years are important in understanding the specific behavioral patterns of the child. The word 'depth' was used to refer to the deep or early life of the child.

Parallel Functional Development of Two Basic Psychological Concepts.—Figure 1 illustrates five parallel independently organized, and functionally developed schools of contemporary psychological thought. The parallel positions are represented by molar or molecular, whole or part, differentiation or integration, central or peripheral, or wholistic or atomistic char-

FIGURE 1.—A PSYCHOLOGICAL CONSTRUCT SHOWING THE PARALLEL FUNCTIONAL DEVELOPMENT OF TWO BASIC CONCEPTS IN PSYCHOLOGY, MOLAR AND MOLECULAR, RELATIVE TO INDEPENDENTLY ORGANIZED POSITIONS OF CONTEMPORARY PSYCHOLOGICAL THOUGHT

Molecular Psychology (Peripheralists)			Molar Psychology (Centralists)		
Number Interest	Name area	Date Contributors	Number Interest	Name area	Date Contributors
I) Instinct Psychology 1900			I) Field Theory 1900		
Learning	McDougall, James, Freud, Thorndike		Physics	Whitehead, Planck, Einstein, Dewey	
II) Conditioning Psych. 1912			II) Organismic Psych. 1925		
Physiology	Pavlov, Watson, Skinner, Guthrie		Organism or physiology	Cannon, Lashley, Goldstein, Woodger	
III) Bond Psychology 1906			III) Gestalt Psychology 1912		
Learning	Thorndike, Gates, Woodworth, Sandiford		Perception and learning	Wertheimer, Kohler, Koffka, Wheeler	
IV) Depth Psychology (1918)			IV) Topological Psychology 1926		
Abnormal psychology	Freud, Adler, Jung, Rank		Motivation	Lewin, Brown, Tolman, Leeper	
V) Functional Psychology 1896			V) Human Ecology 1950		
Adaptation and learning	Dewey, Angell, Burton, Orata		Social psychology	Allport, French, Lippitt, Watson	

acteristics, respectively. Figure 1 does not presume to be an all-inclusive list of contemporary schools of psychology. The author believes, however, that it does represent, in one of the several parallel categories, the major independently organized stages or periods of development.

The parallel position indicated in Figure 1 appears to be less cogent in its functional relationship than the vertical or longitudinal one. Within the limits of the parallel concepts, however, molar and molecular, the parallel position represents the best or optimum position of relationship even though it may be quite remote in some instances. The practical and significant relationship appears to be the vertical or genetic one, considered functionally and not chronologically. This genetic relationship appears to be direct, cumulative, and continuous. The descending order suggests that the respective parallel positions are related to each other as a species to a genus. They share a common temper, but differ slightly in terminology, content emphasis, and characteristic choices of problems to be investigated. Each succeeding stage incorporates most of the accepted developments of the previous one, but tends to go beyond that in its development. The germ of each position is to be found in the stage or stages that precede it on the construct. Positions are not presumed to incorporate closed, discrete, or isolated characteristics not related to other positions on the longitudinal or genetic scale, functionally considered. (Hartmann, 1942, and Hilgard, 1948.)

A Synthetic Concept of Motivation.—Motivation appears to have two basic aspects: (1) goal-setting, and (2) goal-striving. All behavior is presumed to result from this process of goal-setting and goal-striving. Man does not simply locomote, Lewin maintains; he locomotes toward or away from some goal. The goal may be conscious or unconscious, but always it is characterized by disequilibrium, tension, and dissatisfaction; and always it is the individual or organism's goal, and not the goal of some other person. Goal-setting implies that the individual has accepted the goal. Early in its experience the child, or organism, learns that locomotion in the psychological direction (where he thinks the goal is) of the goal tends to restore the equilibrium, reduce the tension, and yields a feeling of satisfaction. This is called goal-striving.

The behavior of the organism for any given time is always the result of the greatest tension area, where the greatest disequilibrium is present, resulting in the greatest dissatisfaction. The degree of dissatisfaction is always relative to the psychological distance to the goal. This psychological phenomena is one of the bases of recent clinical interpretations, psychoanalysis, non-directive counseling, projective interpretation, and the 'need' theory in education. Valid measures of the presence of tension areas are indicative of unsatisfied needs in the individual or organism.

Satisfaction is not necessarily predicated upon reaching the goal, but on approaching the goal. The medical student who has just finished successfully a course in physiology receives a great deal of satisfaction, even though he has not yet passed his medical exams. There are always many goals, and their interrelatedness is complex. Success or failure is determined by the extent to which the individual attains the goals which he has set for himself; not the teacher's goals nor his own potential. His goals are referred to as his level of aspiration; the word 'level' referring to a comparison of the goal with some past performance of the individual on the same task.

A Genotypical Retrospect of Synthetic Motivation.—The nucleus of the psychological premise that all behavior is goal-directed stems from the early 'instinct' psychologists, sometimes called the 'purposivists'. McDougall described in great detail how all behavior is directed toward some end. Woodworth described 'situational-set' as an 'inner' steer which gives rise to goal-directed activities. Tolman demonstrated the goal-directedness of animal behavior, Lewin and Carl Rogers have demonstrated that psychological therapy obeys the same principle, progressing from ego-status to ego-ideal. The tension concept stems from the early reflexologists who described readiness of the individual for behavior in terms of nerve or muscle tension. Guthrie included the kinesthetic nerve structure in describing the state of tension. The organismic psychologists describe the tension in terms of equilibrium or homeostasis; while the gestalt school speaks about the laws of *pragnanz*, the law of continuation, and the law of closure.

The satisfaction concept stems from the early Epicurean 'pleasure-pain' theory of philosophy; the Hedonistic school

under J. S. Mill; Thorndike's earlier and later laws of effect and spread of effect; Hurlock and Estes' work on reward; Wyatt and Mayo's studies of attitudes; and Lewin and his followers' work on the level of aspiration.

The basis of the concept that goals may be conscious or unconscious stems from the early work of Charcot, Janesch, and Liebault on hypnosis and therapy; the threshold of consciousness of Herbart; the psychic-determinism of Freud; and more recently from Masserman's experiments with animals and humans. The latter found that animals whose thyroid gland has been removed tend to select the salt-iodine-solution which they need to survive, over fresh water. Before the thyroidectomy the salt-iodine solution was refused. Similarly, children with rickets choose cod liver oil which they had refused before the rickets. Apparently they were not conscious of the need. Lester Beck has demonstrated the effect of a depth or early childhood experience on later behavior by use of the hypnosis technique.

Einstein's Theory of Relativity and Motivation.—In the last two paragraphs above some attempt was made to describe motivation phenotypically and genotypically. An attempt will be made below to describe it functionally from the standpoint of the psychological field or life-space of the individual. Here behavior is always directed at maintaining the 'ego-status' of the individual in his life-space, or psychological field. 'Ego-status' is predicated upon the physical and social status of the individual, and so it is the more comprehensive of the three terms. The 'ego-status' of the individual is always relative to his level of aspiration, or the goals he sets for himself. When he attains or approaches these goals, he experiences success, and when he fails to attain them, psychologically, he experiences failure. The level of aspiration of the individual is set very largely on the basis of what the individual believes essential to maintain status in the group in which he holds psychological membership. In general, the group tends to lower the level of aspiration of the gifted person, and to raise the level of aspiration of the dull. This results in a type of levelling-off process, similar to Mendel's law of regression. In respect to the goals of the gifted and the dull, a spurious psychological pacing condition exists. The gifted person with mediocre goals is experiencing success, when in reality he should be experiencing failure relative to his potential. The dull person, on the other hand, has set his goals up

to conform to those of the group, and he is unable to experience success, although he is succeeding in relation to his potential. Obviously some attention must be given these two groups, as well as to their parents and their teachers, in the way of psychological orientation.

Because of the psychological nature of motivation, the individual tends to locomote toward areas that inflate his ego, and away from areas that deflate his ego; toward areas where he experiences success, and away from areas where he experiences failure. Always our ego is with us and seeks status in our psychological field. Whether we develop a dual personality for different situations or escape into the world of phantasy or utilize the mechanisms described by Freud is determined solely on the basis of ego status. When we are unable to maintain status in the typical class of personality, we may switch to the atypical class, or to the abnormal class, or, when all else fails, commit suicide.

The individuals psychological field or life-space determines the criteria for his status at any given moment, influences his level of aspiration, and indirectly determines whether or not he can continue to face life; thus it is of primary importance psychologically. In no case may this field be limited to the finite world, or even to physical manifestations. The Angel Gabriel who is presumed to have taken little eight-year old Mary's father to Heaven last summer, is more real in her psychological field than the voice of the teacher who has just reprimanded her for 'daydreaming.' The boy who sits next to Harry Oliver in Latin class may be far less real to Harry than his father, about whom he has been thinking, but who is on the front battle lines in Korea so far as his psychological field is concerned. Means must be found for structuring the situation so that the entities in the individual's life-space, whether they exist in some finite way and we can measure them or not, are compatible and reconcilable with our other psychological relationships with the individual. This principle will determine the presence of delinquency, homicide, divorce—or socially acceptable behavior.

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THE USE OF STUDENT-RATING SCALES IN THE EVALUATION OF INSTRUCTORS IN INTRODUCTORY PSYCHOLOGY

A. W. BENDIG

University of Pittsburgh

The problem of evaluating the teaching effectiveness and skill of college instructors has received scant consideration in contrast to the similar evaluation of elementary- and secondary-school teachers. This situation is especially indefensible among psychologists who are presumably experts in measuring human behavior, yet have neglected the application of their evaluation techniques to their own classroom effectiveness. Even today with the rise of applied fields such as clinical psychology one of the major activities of the psychologist is in college and university teaching.

The basic problem in any evaluation of psychologists as teachers is the old, old dilemma of the criterion. On what basis are we to judge the teaching ability of ourselves and our fellow psychologists? The criterion used generally devolves into four areas: (1) objective test scores of personality or intellectual traits, (2) ratings by supervisors of teacher-training, (3) ratings by officials of the employing institution, and (4) student ratings of their instructors. In general, no single criterion is recognized as being sufficiently adequate, but a multiple criterion based on several different procedures appears to be both more reliable and valid.

The problem is of greater importance in departments of psychology that provide their graduate students with opportunities for student-teaching as part of the training curriculum leading to the Ph.D. degree. Some system of evaluation is needed for the diagnostic measurement of teaching inadequacies as a means of aiding the fledgling pre-Ph.D. to improve his teaching techniques and also as an objective basis for recommendations for teaching positions at other institutions. In the Department of Psychology at the University of Pittsburgh, the policy is to initiate a series of research studies on various components of a multiple criterion of the teaching effectiveness of graduate students handling undergraduate psychology courses.

The purpose of this report is to present the results of using one set of instructor rating scales to evaluate the teaching effectiveness of instructors in introductory psychology. The same rating scales were also used in more advanced undergraduate psychology courses, but the data on their use in these courses are not available at present. The scales are fourteen five-point rating items devised by Crannell[1] and are described in his article. These scales were given to all under-graduate students at Miami (Ohio) University and the results indicate that the scales are promising attempts to measure student attitude toward instructors and courses. The scales cover course organization, instructor attitude, grading system, and teaching characteristics of the instructor. Most of the relative aspects of teaching from a student's point of view appear to be tapped by the wording of the scales.

The present report deals with the use of these scales in introductory psychology. Our primary question was whether the scales were sensitive enough to discriminate the individual differences in teaching effectiveness among a group of introductory psychology instructors. If the scales are to be useful for diagnostic or evaluative purposes they must be capable of demonstrating these individual differences between instructors. To test the hypothesis of adequate discrimination the scales were given to a large number of introductory psychology classes which were taught by a relatively heterogenous group of instructors in terms of teaching techniques and personalities.

SUBJECTS

The instructors.—Of the ten instructors of daytime sections of introductory psychology, one has the rank of associate professor, three are instructors, and the remaining six hold appointments as part-time lecturers in addition to being full-time graduate students working toward the Ph.D. degree. The associate professor and one of the instructors hold the Ph.D. degree. The two instructors in the evening sections are both part-time lecturers and graduate students. All of the daytime instructors had a minimum of two semesters of experience of teaching some phase of psychology to undergraduate college students before the beginning of the semester in which the ratings were taken. The median age is approximately twenty-seven years. Two of the

lecturers were women, the remainder men. One remaining daytime lecturer did not give the rating scales to his single section and consequently is not included in this report.

The students.—There were four hundred ninety students in fourteen daytime sections and one hundred twenty-seven students in three evening sections. A breakdown as to percentages of students by class and school in both daytime and evening sections can be found in Table 1. These percentages are based upon a survey of all students made at the beginning of the semester. In general, the daytime student fits the picture of the average college student at most institutions. In contrast, the evening student is older and is usually only a part-time student with some outside occupation.

TABLE 1.—PERCENTAGES OF STUDENTS BY CLASS AND SCHOOL IN DAYTIME AND EVENING SECTIONS

Variable		Daytime		Evening	
		Men	Women	Men	Women
Sex		61.8	38.2	31.6	68.4
Class:	Freshmen	14.9	38.7	18.6	16.9
	Sophomore	46.6	51.0	20.3	23.8
	Junior	19.6	7.4	11.9	9.2
	Senior	17.8	2.1	8.5	1.5
	Non-degree	1.0	0.8	40.7	48.5
School:	College	60.8	83.1	40.7	33.8
	Bus. Ad	21.5	2.9	30.5	3.1
	Engineering	15.9	0.0	8.5	0.0
	Nursing & Ed	1.8	14.0	20.3	63.1
Age:	Median year	20.9	18.6	28.1	24.7

The course.—The particular course in introductory psychology involved here is a beginning, one-semester course carrying three semester hours of credit. The course, or a companion two-semester general course with laboratory facilities, is prerequisite to more advanced courses for undergraduate students. There is no laboratory requirement for the course, although classroom demonstrations and instructional films are presented during the

semester. There are three major examinations and a final test during the semester. The three major examinations are objective, multiple-choice examinations based upon material in the textbook. The final examination is based upon both text and lecture material. Scoring and grading is on a departmental basis, as is the construction of the major examinations.

PROCEDURE

Each instructor gave the scales to his own classes with the request that the students rate their instructor and the course as objectively as possible. It was emphasized that the instructor's position did not depend on the ratings, but that the ratings would aid the instructor in correcting and improving his teaching. The ratings were anonymous, as the students were requested not to sign their names to the ratings. Their ratings were recorded on five-choice IBM answer sheets for later machine scoring. All ratings were turned over to the faculty member in charge of the introductory course for the scoring and evaluation. The results reported below are based upon this scoring and evaluation.

RESULTS

The most important question about the scales was whether they were sensitive enough to demonstrate significant differences between instructors in introductory psychology. If these rating scales were to be used in the future as part of a multiple criterion of teaching competence, then they must be capable of showing differences between instructors.

Each of the fourteen scales was separately treated by several statistical techniques. The five points on each rating scale were arbitrarily weighted from one to five with a score of one representing the most favorable response on that scale. Means and standard deviations for each scale based upon all four hundred ninety student ratings were computed. In addition, a simple analysis of variance was computed on each scale comparing the variability between instructors with the variability within instructors. The resulting F ratios were then evaluated as to the probability that there are significant differences between the instructors on the scale. The final step was the quantification of the discriminating power of each scale by computing an

epsilon correlation ratio by the formula given in Edwards[2] (p. 234). The results of these computations can be found in Table 2. Twelve of the scales are capable of discriminating among daytime instructors at the .001 level of confidence. The generally less significant values of epsilon among the evening instructors is, to a large extent, attributable to the restricted sampling of instructors among the evening sections; only two instructors being involved. Perhaps a wider, more representable sampling of instructors among the evening sections would have resulted in higher epsilon values.

In general, the bunching of ratings toward the low, or favorable, end of the scale was evident. Table 3 gives the percentages

TABLE 2.—MEANS, STANDARD DEVIATIONS, AND EPSILONS COMPUTED ON STUDENT RATINGS OF INTRODUCTORY PSYCHOLOGY INSTRUCTORS AT THE UNIVERSITY OF PITTSBURGH ON THE MIAMI UNIVERSITY INSTRUCTOR RATING SHEET

Item	Daytime					Evening				
	N	M	σ	ϵ	P	N	M	σ	ϵ	P
1	461	2.46	0.95	.30	.001	119	2.86	1.00	.00	.50
2	488	2.38	1.16	.46	.001	125	2.59	1.07	.19	.05
3	483	2.29	0.71	.20	.001	125	2.36	0.72	.24	.01
4	483	1.53	0.62	.62	.001	125	1.64	0.68	.36	.001
5	478	2.15	0.85	.24	.001	124	1.94	0.97	.59	.001
6	483	1.87	1.01	.33	.001	125	2.22	0.94	.00	.50
7	479	1.74	1.01	.22	.001	122	2.35	1.30	.25	.01
8	477	2.51	0.97	.23	.001	124	2.46	0.95	.00	.50
9	482	2.07	1.25	.14	.05	126	2.17	1.28	.00	.50
10	482	1.72	0.83	.34	.001	125	1.72	0.84	.34	.001
11	482	2.21	0.95	.31	.001	125	2.72	1.03	.31	.001
12	481	1.95	0.73	.36	.001	126	2.24	0.92	.51	.001
13	481	2.39	0.97	.36	.001	122	2.43	1.17	.45	.001
14	475	2.62	0.83	.17	.05	126	2.95	0.93	.19	.05
Median				.305					.245	

TABLE 3.—PERCENTAGES OF STUDENTS (N = 490) USING EACH OF THE CHOICE-POINTS ON THE MIAMI UNIVERSITY INSTRUCTOR RATING SHEET

Item	Category					Omit
	A	B	C	D	E	
1	9.8	49.0	21.6	9.8	3.9	5.9
2	29.2	25.3	23.5	17.1	2.9	2.0
3	10.8	52.7	31.2	3.7	0.2	1.4
4	51.8	42.0	3.5	1.2	0.0	1.4
5	17.8	57.1	12.9	9.6	0.2	2.4
6	47.1	26.3	17.6	5.9	1.6	1.4
7	54.5	23.1	14.1	3.5	2.7	2.2
8	12.7	39.2	33.9	6.9	4.7	2.7
9	43.9	23.9	18.2	4.3	8.2	1.6
10	50.0	28.4	17.8	2.2	0.0	1.6
11	23.5	41.8	23.1	8.8	1.2	1.6
12	24.5	57.1	13.9	2.0	0.6	1.8
13	25.1	26.5	33.3	10.0	3.3	1.8
14	8.4	31.8	47.1	7.8	1.8	3.1

of ratings at each of the five choices on each scale. This table can be compared with the similar table given by Crannell for ratings of all instructors (psychology and otherwise) at Miami University,[1] (p. 9). On most of the scales the concentration of ratings near the low end of each scale was not quite as evident in our sample as in Crannell's, but several of the scales are, to all intents and purposes, only four-point rating scales. Note particularly scales 4 and 10 in Table 3. It is to be noted, also, that the percentages of students omitting ratings is higher for our sample than for Crannell's. However, there is evidence that the omission of ratings was random from section to section and from instructor to instructor and did not affect the mean ratings of instructors.

DISCUSSION

It was not, nor is it now, proposed that student ratings of instructors should constitute the single criterion of teaching

effectiveness. However, if we view the students in introductory psychology as part of the consuming public for our teaching efforts then the students' appreciation of the characteristics of the teachers should partially influence our evaluation. Such a series of ratings are viewed as forming a part of a multiple criterion of teaching effectiveness with faculty ratings of speech

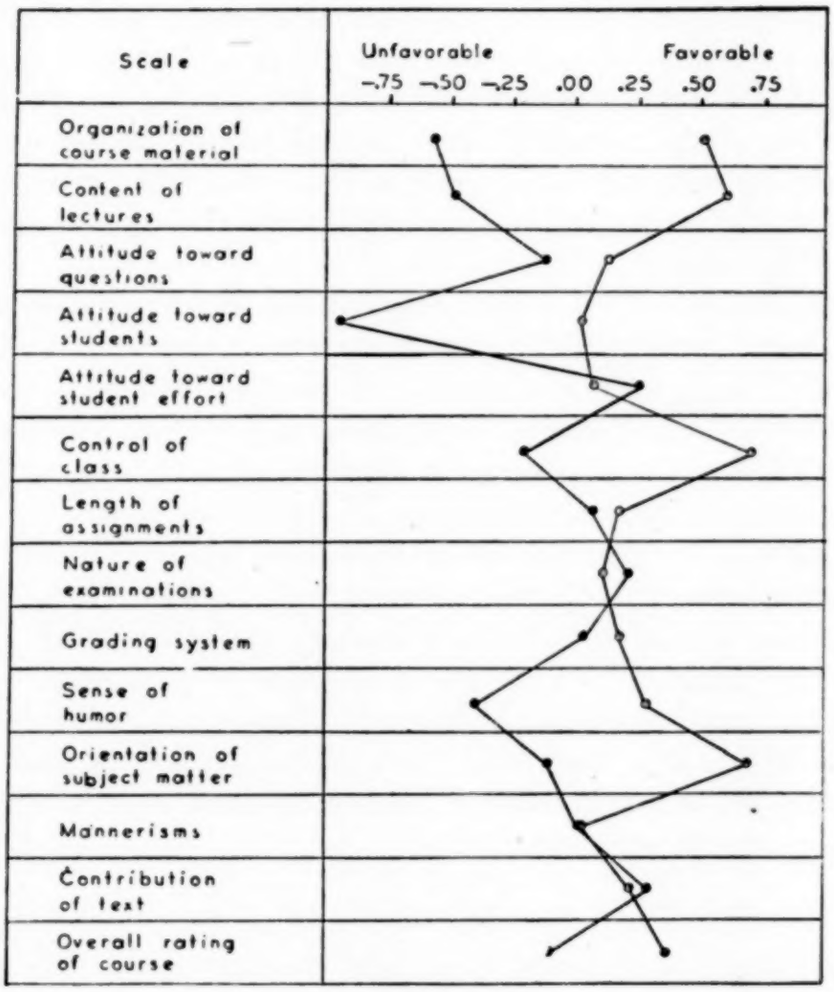

FIG. 1.

patterns, content of presentation, and use of illustrative material, plus objective test records forming other segments of the total criterion. Our problem at this stage is of devising student rating scales that can be statistically shown to discriminate reliably the individual differences between instructors. Later these scales can be validated and related to other factors in the total criterion by experimental and correlational procedures.

In the light of this initial problem the present scales, with two exceptions, appear to be satisfactory. Twelve of Crannell's fourteen scales reliably discriminate, at the .001 level, among daytime instructors. The remaining two scales, asking for more generalized evaluations, appear to lack the necessary discriminatory characteristic. The discrimination of all fourteen scales probably can be increased by modifying the wording of the scales to achieve a less skewed distribution of ratings. The next step will be to refine the scales more at the favorable end of each continuum to achieve a finer discrimination among the generally favorable ratings. Both greater reliability and validity may be achieved by defining the choices on the scales more precisely in terms of the instructors' behavior while still allowing for student projections of course evaluation.

As an example of the extreme individual differences in patterns of instructor ratings Figure 1 presents the profiles of two instructors labelled X and O. The scores are the deviations of each instructor's mean ratings from the scale means reported in Table 2 and with each deviation divided by the standard deviation of the particular scale involved. In a sense these are standard scores, but typically range only between -1.00 and 1.00 standard scores since the raw score on each scale for an instructor is a mean of many individual student ratings. Mean scores cannot be expected to fluctuate as much as single scores.

Profiles such as the two shown in Figure 1 have been used diagnostically and from subjective verbal reports of associates and from the verbalizations of the instructors themselves appear to have considerable validity.

SUMMARY

The Miami University Instructor Rating Sheet was given anonymously to four hundred ninety daytime undergraduate and one hundred twenty-seven evening school students in introductory psychology at the end of the course semester. Twelve of the fourteen scales reliably discriminated among the ten daytime instructors at the .001 level and the other two scales at the .05 level. Six of the scales demonstrated differences at the .001 level between the two evening instructors and four of the scales showed no discrimination in evening classes. All of the scales appeared to have a favorable bias. The conclusion is drawn

that the scales are useful as part of a multiple criterion of teaching effectiveness and can be improved by revising the scales to achieve a more symmetrical distribution of student ratings.

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A FACTOR IN THE DEGENERATION OF DISCUSSIONS

ROY GLADSTONE

Oklahoma Agricultural and Mechanical College, Stillwater

The reasons for the degeneration of verbal negotiations, resulting as it often does in overt aggression, is an important problem of our time. This paper is an attempt to examine one likely partial cause of such degeneration and offer a vivid aid in driving that cause home to the student.

One way of defining the difficulty of a mental feat is to discover how old the average child must be before he is able to accomplish it, the older he must be the more difficult the task is assumed to be. If a number of tasks are arranged in order of difficulty (defining the difficulty in this way) it has been the writer's experience that a given individual who attempts to work all the mental tasks from easiest to hardest will ordinarily have a feeling that the tasks are getting harder as he progresses—he has a feeling of increased effort or strain until he gets to the point where he is completely baffled. If he is asked which are the harder problems, his designation will ordinarily agree fairly well with the order of difficulty as defined. An instance is the feeling of an individual attempting to define the words of the Stanford-Binet.

Many people tend to think of the difficulty of mental tasks entirely in this way—that dull people work hard to solve a problem which bright people find easy; that the bright people, in turn, work harder as they get to problems which the duller cannot work; and that the easiest problems are easiest for all. That this view has considerable validity is indicated by the success of mental scales. That it is not the only way of looking at the problem of task difficulty is brought home very forcibly by experience with the Rorschach.

The Rorschach presents a task of organization and interpretation. When the subject is confronted with a series of blotches on the card, it is possible to see meaning in one or more of the separate blotches, to see meaning in the blotches plus their organization, or both. To the novice, one of the most surprising things about the Rorschach is the difficulty others

have in seeing what he sees so immediately and vividly. Yet, a minimum of experience with the test will convince him that one individual, whatever his level of intelligence, may find it difficult or impossible to see much of what anyone else sees until the other helps him and he makes a considerable expenditure of effort. This is true whatever the other individual's level of intelligence, or intellectual level of response. Thus the intelligent person who sees a 'whole' may find it difficult or impossible to see an isolated detail. Yet, in general, good wholes are generally regarded as requiring a higher level of intelligence than detail interpretations. Using the criterion of the intelligence test one would say that interpreting good wholes is more difficult than interpreting details. Yet the intelligent person with a particular kind of psychological organization finds the real situation to be quite the contrary. Here is a situation, then, in which some intelligent persons find it difficult not only to see what others, dull or intelligent, see, but find it more difficult to do the 'easy' task (do what dull people do; interpret details) than to do the 'hard' task (do what intelligent people do; interpret wholes).

An integration of the facts outlined above suggests a possible reason for the degeneration of discussions. No one likes to negotiate with an individual who is not being sincere. It is easy to believe that what is elementary and the easiest solution to a problem to you is also easiest for another. If the other views the situation in another way—a way which is difficult for you to see—it is easy to believe that the other is just being stubborn, perverse, or dishonest. It seems reasonable to suppose that this lack of insight into the individuality of organization is a factor in the breakdown of discussions at the political and economic levels where, as in the Rorschach, there are many details and many possible ways to interpret them.

It is obvious that a more complex theoretical structure is necessary to explain the phenomena described above than is afforded by the intuitive feeling that one task is quite simply harder than another. This theory is supplied by that system which views the complex individual interacting with a complex environment to achieve a stable energy organization, the results for any given individual-environment interaction differing from others due to the particular variables represented by the individual or environment,[2] (pp. 791–844). Thus, for some indi-

vidual-environment (individual-task) interactions there is no hierarchy of difficulty which can be defined by increasing feeling of strain which is substantially the same for most people. Rather, there is simply the different reactions of different people to the same environment, each individual's first reaction appearing to the individual to be the easiest—each individual having a particular interpretation which represents the least energy output for him but for few or no other individuals.

For the teacher who is attempting to illustrate the individuality of interpretation the ink-blot ought to present a vivid and culturally neutral starting point. While the discussion above was inspired by the Rorschach it does not seem desirable to use the Rorschach to illustrate the point since the test should remain an unknown quantity if it is to be most useful as a clinical instrument. Probably any of the ink-blots which are printed in the various texts will do [1] (p. 435).

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NOTE OF CORRECTION

In the matter of "Community Variables as Predictors of Intelligence and Academic Achievement," October, 1951, issue of THE JOURNAL OF EDUCATIONAL PSYCHOLOGY, an unfortunate clerical error was made in Table I, page 331, and the order of columns and rows got shifted. The last column and row should have been the first, and all others should have been moved one position to the right and downward. A corrected version of the table is given herewith. Recipients of the JOURNAL are requested to make a note on page 331 to this corrected table, or, if they prefer, a reprint of the corrected table will be sent upon request to the author, and this may be inserted in its proper place in the October issue. The author deeply regrets the slip.

ROBERT L. THORNDIKE

Teachers College
Columbia University
New York City 27.

Table I.—Intercorrelations of 24 Predictor Variables (N = 154)*

Variable Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1		−32	−29	20	−12	22	−10	10	32	−04	00	03	−06	−49	47	00	−15	−21	34	14	−02	−08	32	29
2	−32		21	10	27	−75	23	−06	−48	06	−65	−63	−20	52	−54	−27	−08	−09	−16	−07	12	09	02	−05
3	−29	21		−80	01	−03	07	06	−25	−14	−09	−01	11	28	−24	46	37	41	−16	−33	−03	−17	−25	−31
4	20	10	−80		16	−22	10	05	16	20	02	−05	−09	−09	06	−46	−34	−38	10	32	22	27	32	32
5	−12	27	01	16		−60	93	25	03	70	−05	01	−30	23	−27	−08	−12	−30	09	37	34	27	24	18
6	22	−75	−03	−22	−60		−53	−23	34	−30	48	47	26	−55	58	47	17	38	−04	−25	−19	−24	−23	−18
7	−10	23	07	10	93	−53		24	08	75	03	12	−30	18	−21	01	−05	−19	03	29	37	27	14	10
8	10	−06	06	05	25	−23	24		29	17	10	16	18	05	−04	−25	−13	−33	39	42	12	20	26	34
9	32	−48	−25	16	03	34	08	29		29	45	62	−01	−62	61	21	02	06	16	13	28	15	01	10
10	−04	06	−14	20	70	−30	75	17	29		14	22	−28	−01	−01	−06	−07	−25	10	45	29	28	06	11
11	00	−65	−09	02	−05	48	03	10	45	14		86	12	−23	25	40	21	28	−05	03	04	05	−33	−18
12	03	−63	−01	−05	01	47	12	16	62	22	86		13	−30	33	45	26	38	−13	−06	12	04	−34	−28
13	−06	−20	11	−09	−30	26	−30	18	−01	−28	12	13		−01	00	04	18	19	−12	−15	01	05	−05	04
14	−49	52	28	−09	23	−55	18	05	−62	−01	−23	−30	−01		−98	−31	−02	−06	−19	−01	−14	−10	−10	−10
15	47	−54	−24	06	−27	58	−21	−04	61	−01	25	33	00	−98		33	06	10	18	−01	12	07	05	06
16	00	−27	46	−46	−08	47	01	−25	21	−06	40	45	04	−31	33		45	68	−23	−45	11	−21	−40	−39
17	−15	−08	37	−34	−12	17	−05	−13	02	−07	21	26	18	−02	06	45		44	−25	−34	04	−04	−34	−32
18	−21	−09	41	−38	−30	38	−19	−33	06	−25	28	38	19	−06	10	68	44		−61	−75	08	−23	−57	−63
19	34	−16	−16	10	09	−04	03	39	16	10	−05	−13	−12	−19	18	−23	−25	−61		66	−09	06	49	57
20	14	−07	−33	32	37	−25	29	42	13	45	03	−06	−15	−01	−01	−45	−34	−75	66		−02	33	54	66
21	−02	12	−03	22	34	−19	37	12	28	29	04	12	01	−14	12	11	04	08	−09	−02		62	20	18
22	−08	09	−17	27	27	−24	27	20	15	28	05	04	05	−10	07	−21	−04	−23	06	33	62		27	42
23	32	02	−25	32	24	−23	14	26	01	06	−33	−34	−05	−10	05	−40	−34	−57	49	54	20	27		70
24	29	−05	−31	32	18	−18	10	34	10	11	−18	−28	04	−10	06	−39	−32	−63	57	66	18	42	70	

* This is a correction of Table I, "Community Variable as Predictors of Intelligence and Academic Achievement," page 331 of October, 1951 issue.

BOOK REVIEWS

HAROLD GULLIKSEN. *Theory of Mental Tests.* New York: John Wiley and Sons, Inc. 1950, pp. 486.

Professor Gulliksen's book admirably answers the need for a basic text in the theory of mental tests; in fact, it bids fair to become the standard work in the field for a number of years to come. Not only does it present in an ingeniously organized form the fundamental theorems on reliability, validity and errors of measurement developed many years ago by Spearman and Kelley, but it also reviews in a balanced way the work of the last ten or twenty years, and presents in detail a number of the most recently developed methods. As if these virtues were not enough, the book is designed as a good textbook. In general, the textual matter and the mathematical development reach high standards of clarity. Each chapter is provided with a series of exercises by which the student can test his comprehension, checking his results with the numerical answers provided in the back of the book. The instructor will be grateful for appendices which give sample examination questions in test theory and statistics. Finally, the book includes an excellent bibliography.

In the introduction, the author is careful to note that the book deals mainly with "the mathematical theory and statistical methods used in interpreting test results" (p. 2). He refers his reader elsewhere for material on the "numerous non-quantitative problems involved in constructing aptitude or achievement tests" (*ibid.*).

Chapters 2 through 9 present the classical treatment of test reliability and its effect on validity, in terms of the basic assumption that the observed score (X_i) of individual i is equal to his true score (T_i) plus an error term (E_i). Out of this basic assumption, along with the usual considerations regarding the mean error and the characteristics of parallel tests, are derived all the usual equations for the reliability of tests, the standard error of measurement, the reliability of lengthened tests, and the relations between the observed, true and error variances. This material could have been presented much more compactly; most of the equations could have been derived first in their most general forms, with easy transitions to the various special cases.

Gulliksen prefers, however, to present the simpler cases and then to generalize a procedure which will probably ease the work of the student. Chapters 2 and 3 present an interesting contrast—in the former, the fundamental equations are derived along the lines of a conceptual model in which it is assumed we know true scores and error scores, while in the latter, the same equations are derived as limits of expressions for K parallel tests as K approaches infinity. Chapter 4 has the merit of clearly distinguishing between four ways of expressing test error; after reading this chapter, nobody will have any excuse to use the standard error of measurement in a situation where he ought to be using the standard error of substitution. Chapter 5 points out a frequently neglected relationship between standard error of measurement and certain quantities computed in the analysis of variance approach to test reliability. Chapters 6 to 8 should give pause to those who still speculate on the 'validity' of the Spearman-Brown equations. Chapter 9 emphasizes again that the correction for attenuation is an application of the correlation of sums.

Chapters 10 to 13 are concerned with the problem of group heterogeneity, and its effect on reliability and validity. Most of this material is a summary of formulations which have been on the books since the early days of statistics, but Chapter 10 presents the extremely interesting work of Mollenkopf on the relation of the skewness and kurtosis of the score distribution to the magnitude of the standard error of measurement, and Chapter 13 gives the most complete account of the effects of multivariate selection now available. Incidentally, this reviewer would urge caution in applying Mollenkopf's formulation to tests where there is a large guessing component, since such a test might not very well fulfill some of the assumptions made in his derivation, in particular that specified by equation (52). Further investigation of the generality of Mollenkopf's derivations is needed.

Test theorists should be grateful to Gulliksen for suggesting to his colleague Wilks the problem of discovering a statistical criterion for parallel tests. This is one of a great many special statistical problems which arise in test theory, and which in many cases are unique to that field. He presents a clearly written treatment of Wilks' results, as well as those obtained

by Votaw for the problem of 'compound symmetry,' the problem of whether tests are parallel with respect to their correlations with a criterion. It occurs to this reviewer to speculate whether the methods are applicable to testing the equivalence of items as well as tests, for in the case of equivalent items the means are functionally related to the variances—a condition not specified in Wilks' development.

Chapter 15, "Experimental Methods of Obtaining Reliability," presents a good discussion of the advantages and disadvantages of the conventional methods of determining reliability (test-retest, alternate forms, split-half, etc.) In addition, it discusses a highly promising technique of constructing random subtests by matching items on difficulty and validity, and gives a neat formulation of the problem of reader reliability. Chapter 16, "Reliability Estimated from Item Homogeneity," is disappointingly short; in essence it presents the rationale for Kuder-Richardson formulas 20 and 21. The next chapter presents an original technique for determining the 'speededness' or 'power-ness' of a test, and indicates possible effects of speededness on reliability. Many will disagree, however, with Gulliksen's definition of a pure 'speed test' as one "composed of items so easy that the subjects never give the wrong answer to any of them." This definition makes the speededness of a test dependent upon the sample being tested; furthermore, it ignores the possible factorial composition of tests in terms of speed and level components. Gulliksen fails to mention the almost classical problems of the correlation of speed and level, though perhaps this is a psychological rather than a statistical problem.

Test constructors will find a number of interesting suggestions in Chapter 18, which concerns "Methods of Scoring Tests," but it is evident that numerous problems still remain in this area. Chapter 19 takes up "Methods of Standardizing and Equating Scores"; much of this material is an elaboration of what can be found in any good text in educational statistics, but the presentation of some of Thurstone's scaling methods and a method for equating forms of a test given to different groups makes the chapter valuable. Chapter 20 is a thorough but difficult essay on problems of weighting scores in a composite, with some reference to the problem of differential prediction. Of particular technical interest is the proof that the crucial

characteristics of a set of weights, insofar as its effect on the correlation of composites is concerned, is the ratio of its standard deviation to its mean.

At the outset of the twenty-first chapter, "Item Analysis," Gulliksen points out that "item analysis is concerned with the problem of selecting items for a test so that the resulting test will have certain specified characteristics," but that the rationale of item analysis has not been developed sufficiently to enable one to control all those aspects of a test which one might desire to control. For example, it seems to be difficult, at the moment, to construct a test with specified indices of skewness and kurtosis, or with specified characteristics of the standard error of measurement. Nevertheless, it is satisfying to know, as Gulliksen demonstrates, that relationships have been established between item parameters and test variance, reliability and validity. These relationships are exact and involve no approximations, when we are dealing with a specified set of items, but they are difficult to use when we are faced with the problem of selecting a subset of items which will maximize test reliability or validity.

Perhaps because of the undisciplined growth of the field, Gulliksen apparently found it hard to decide what was to be covered in the book. The treatment is uneven in difficulty level: some of the material is almost laboriously elementary, while other parts will challenge even the best-prepared student. (In his preface, Gulliksen suggests omissions permissible to students with minimal preparation.) On the other hand, a number of topics are passed over as "beyond the scope of an elementary treatment": for example, analysis of variance methods of assessing sources of unreliability in a test (p. 221), scoring methods for determining "level reached," and certain absolute scaling methods (p. 245). The book is not a comprehensive review of all the significant work that has been done in test theory; many important items in the bibliography are not even alluded to in the text. To have provided full discussion of these would have lengthened the manuscript considerably, of course. Nevertheless some space might have been saved for fuller discussion of recent advances by condensing some of the earlier chapters.

Perhaps the most disappointing feature of this book, despite its over-all excellence, is that little attention is paid to relations

between conventional test theory and (a) the technique of factor analysis in isolating the trait dimensions measured by tests, and (b) psychophysical theory. Such omissions can hardly be traced to any fault of the author, however, for little work has been done along these lines in any case. The omissions merely serve to point up the fact that test 'theory' does not yet have a rigorous theoretical foundation; instead, it is a collection of formulas based on a very small number of assumptions concerning true scores, error scores, and the like. Except in a few instances, problems of statistical inference regarding population parameters have not been worked out. Furthermore, most of the formulations deal with tests whose items are scored 'right' or 'wrong,' and few persons have ventured to consider the more general problems raised by other types of test situations, or by tests designed to measure personality traits, interests, or attitudes. It is this reviewer's belief that a rigorous theory of tests can be developed only by considering the characteristics of various types of psychometric scales and the properties of various stimulus-response situations in relation to those scales. It is to be hoped that Gulliksen's work will stimulate new efforts in these directions.

JOHN B. CARROLL
Harvard University

E. C. TOLMAN. *Collected Papers in Psychology.* Berkeley: University of California Press, 1951, pp. 269.

This book is sponsored by Professor Tolman's colleagues and former students in commemoration of his years, more than thirty, at the University of California. In addition to being a fitting commemoration to an illustrious psychologist it is "an important psychological document which shows the development of his systematic theory from its early . . . stirrings to its later more consolidated but still maturing phases."

The volume consists of nineteen articles and papers selected, by Tolman, from a bibliography of more than eighty titles, as those best representative of the "steps in the development of his theoretical system." The book begins with "A New Formula for Behaviorism," *Psychological Review*, 1922, and ends with his celebrated "Cognitive Maps in Rats and Men," *Psychological Review*, 1948.

J. B. STROUD
State University of Iowa

FRANK S. FREEMAN. *Theory and Practice of Psychological Testing.* New York: Henry Holt and Company, 1950, pp. 518.

According to the author's preface, "In the developing scientific field of psychological testing, there is recurrent need for periodic presentation of comprehensive descriptions of tests. This volume is intended to meet such a need." His success in achieving this objective is good in the case of individually-administered intelligence tests, not quite as good in so far as group tests of intelligence and projective methods are concerned, and decidedly spotty in the case of group tests of aptitude, achievement, interest and personality.

There are sixteen chapters. The first three lay the basic theoretical foundation for the rest of the book; after one devoted to such basic ideas as objectivity and norms comes the customary once-over of essential statistical terms and concepts (prepared for this book by T. A. Ryan). The third is a good introduction to definitions and analyses of intelligence. The next six chapters are devoted to the measurement of intelligence: two on the Binet and its revisions, one on performance scales, two on verbal and nonverbal group tests, and one on scales for infants and preschool children. Succeeding chapters deal with aptitude tests, educational achievement tests, personality inventories and rating scales, projective methods, and situational tests. A later chapter considers the use of intelligence tests as clinical instruments, for purposes of obtaining diagnostic interpretations. There is a final chapter entitled "Applications and Problems," in which major emphasis is placed on the nature-nurture controversy and the constancy of the IQ, applications being more summarily treated.

About a hundred and thirty different tests are listed by title among the entries in the index. This ought to be enough to provide for a reasonably representative presentation in each of the fields considered. However, the reader who looks for the comprehensive survey which the book's jacket promises will be disappointed.

For example, tests of clerical aptitude are represented only by the relatively complex *General Clerical Test* and *Detroit Clerical Aptitudes Examination.* There is not even a passing reference to any of the simpler clerical tests, such as the *Minne-*

sota. The entire subject of tests for clerical workers is dismissed in a couple of pages—about half the space that is given to tests of aptitude in the visual arts. Tests of mechanical aptitude, on the other hand, receive considerably more space, as do motor and manual ability tests. Interest inventories are treated as a subsection under aptitude tests, while public opinion polling is considered as an item among personality inventories and rating scales.

Freeman is at his best in his critical discussion of the evidence of validity offered for such group tests of intelligence as the *California Tests of Mental Maturity* and the *Cattell Culture-Free Test.* That this thinking is organized largely around the testing of intelligence is again apparent in his careful consideration of the test batteries (e.g., the *Chicago Tests of Primary Mental Abilities*) which are essentially efforts to partition intelligence, while no mention at all is made of the batteries organized for guidance purposes such as the *Differential Aptitude Tests* and the U.S.E.S. *General Aptitude Test Battery.*

To a considerable extent, Freeman's viewpoint is typified by his comment in the preface that, "After the results of testing are available, in an individual instance, the psychologist may then seek causal and explanatory factors." He seems to belong to the test-to-see-why, or diagnostic school. There is more often a flavor of looking backward from the test results, of using a test when there seems to be something wrong, than of the forward-looking viewpoint which aims at helping normal students or counselees to do sensible educational and vocational planning.

Those school psychologists whose chief concern is the individually-administered intelligence scale will find this book worth while. So, perhaps, will the clinical psychologist, although it may seem to him rather dry and academic, less rich in clinical insights than Goodenough's recent *Mental Testing.* The director of guidance and the counselor may skim it, but will miss nothing of importance if they bypass it in favor of such recent books as those by Super and Cronbach. The employment tester might as well skip it entirely—very little in it is considered from his point of view.

All in all, this has the air of a book begun not later than 1946 or 1947. If published at that time, it would have had a clear field for a while. But the bumper crop of books on various

aspects of measurement appearing in 1948 and 1949 left only a relatively small corner of the back seat for this one in 1950.

J. H. Ricks, Jr.

The Psychological Corporation

Elizabeth A. Simpson. *SRA Better Reading Book 2.* Chicago: Science Research Associates, 1950, pp. 88.

Use of the materials in this book is designed to help the student measure and improve reading rate and comprehension. It is primarily for students who read at seventh- and eighth-grade level. The book, which is accompanied by an instructor's guide, may be used over and over. Responses are made in a reading progress folder. There are twenty article tests in the book. Each article contains 1350 words and is followed by a twenty-item test of comprehension. Speed is in terms of time to read the article. The tests are practically self-administering. Pupils are supposed to have training in speed and comprehension between successive tests. Suggestions for this practice are listed.

In general, the materials are well organized to accomplish the purpose outlined, i.e., measurement of rate and comprehension in reading. The articles selected for reading cover a fairly wide range of subject matter and are interesting. The comprehension questions are well organized. Nevertheless, the book does have certain limitations: (1) There is little emphasis upon the more exacting type of reading found in science and mathematics. (2) The emphasis is largely upon comprehension of details. This is only one of the several comprehension skills needed by the junior-high-school pupil if he is to adjust satisfactorily to all reading tasks. (3) Speed of reading receives a greater emphasis than the reviewer would advocate.

Miles A. Tinker

University of Minnesota

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